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PRACTICAL SUGGESTIONS FOR FRUIT GROWERS.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., August 21, 1902.

SIR: I have the honor to transmit herewith, and to recommend for publication as a Farmers' Bulletin, the manuscript of an article on Practical Suggestions for Fruit Growers, prepared by Mr. H. P. Gould, assistant in the Office of the Pomologist of this Bureau. The bulletin has been prepared under the direction of the Pomologist, Col. G. B. Brackett, and is the outgrowth of a great demand for concise information on practical problems which confront the fruit grower.

Very respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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PRACTICAL SUGGESTIONS FOR FRUIT GROWERS.

INTRODUCTION.

The object of this bulletin is to discuss briefly some of the fundamental factors which enter into the successful and progressive management of fruit plantations. It is intended to be a practical presentation of principles rather than a description of methods.

Fruit growing as a commercial industry is becoming more and more a specialized business and one that requires peculiar adaptations on the part of those who would follow it successfully. The man himself is one of the most important factors in the business; it is not every one who can make a success of fruit growing. This fact finds abundant demonstration. It is a frequent observation that of two men living side by side with equal advantages for growing fruit, one has abundant crops and has become prosperous and independent therefrom: the other finds his fruit plantations a burden. He is not by nature adapted to the business. But perhaps the latter may make a great success of stock raising, while the former is as great a failure at this as the latter is at growing fruit.

Fruit growing should be considered from two points of view—that of the small plantation intended to supply fruit for home use only, and that of more pretentious efforts involving commercial interests. While the fundamental principles are the same, the details must naturally vary to suit the two ends in view. For instance, in locating the home plantation, convenience to the house should be a ruling factor. And again, many choice varieties not suitable for shipping may be grown with satisfaction for home consumption. In many other ways the object of the planting should regulate the details.

THE LOCATION.

Many of the mistakes in fruit growing can be corrected when once they are discovered, but errors arising from faulty locations are generally irreparable. Hence the importance of exercising great care in this particular.

TRANSPORTATION FACILITIES.

Due consideration must be given in commercial fruit growing to the means of getting the product to market. Many places otherwise favorable for producing the very best fruit are of no value for this purpose because of inadequate means of transportation. On the other hand, good shipping facilities practically annihilate distances, so that very perishable fruits can be grown at great distances from the place of consumption.

If there are competing lines of transportation, cheaper rates can often be secured, and if there are both rail and water facilities for shipping, it may be an advantage.

It is likewise obvious that long hauls over rough roads to the shipping station should be considered in locating fruit plantations. It has frequently happened that growers have disregarded this factor, and later have found that the cost and inconvenience of getting the fruit to the station are so great as to render their plantations of little commercial value.

THE SOIL.

The character of the soil influences in a decided way the character and quantity of the product. This fact should be kept prominently in mind in locating fruit plantations, and a soil selected that is suitable for the fruit which is to be grown. Of course, by properly handling the soil and using great care and good judgment in selecting varieties, a wide range of soils for any given fruit may prove satisfactory, but a natural adaptation is desirable.

PROXIMITY TO WATER.

The adaptability of a region for fruit growing is frequently dependent upon the fact that it lies within the influence of a large body of water. This is illustrated in the Chautauqua grape belt of New York, and also in the Keuka Lake grape district. In these two sections the commercial vineyards are in close proximity to Lake Erie and Keuka Lake, respectively. At points remote from these bodies of water the danger of late spring and early fall frosts is too great to warrant any extensive attempt at commercial grape growing. This fact is further illustrated in the peach-growing sections of Michigan. The most of the fruit is produced in orchards which are within the sphere influenced by Lake Michigan.

The influence of large bodies of water manifests itself in retarding the development of vegetation in their vicinity in the spring so that injury from late frosts is avoided, and also in extending the season in the fall. Where such locations can be selected, the probability of immunity from frost injury is greatly increased.

FOGS.

Locations that are subject to frequent fogs are not suitable for the growing of fruit; the effect is to produce fruit of a more or less clouded and consequently unattractive appearance. Generally speaking, the valleys and lower levels are more subject to fogs than the elevated areas, but this is not always the case. The writer has in mind a peach orchard on the top of a mountain, with an elevation of 2,100 feet, which suffers more from the effects of fogs than orchards growing farther down the side of the mountain. In this case the fogs seem to float along the ridge and down the valley rather than over intermediate areas along the sides of the mountain.

TEMPERATURE LIMITS.

While all the factors which go to make up the climate of a place must have an influence upon the adaptability of that place to fruit growing, it is doubtless true that the temperature factor is the most important one. These limitations are perhaps more sharply defined in case of the tropical fruits than they are with those grown in temperate climates. In the one case the limits of growth are restricted to frostless areas, while in a general way the subtropical fruits are confined to sections not subject to what are commonly termed "freezes." In a like manner locations subject to late spring or early fall frosts should be avoided.

THE SITE.

Site refers to the exact place to be occupied by the plantation. In a general way it should be on a more elevated plot than the surrounding area. Such a site will make good soil drainage possible, and it will also insure perfect air drainage.

If the soil does not have good natural drainage, some artificial methods are essential.

Air drainage is a factor seldom sufficiently regarded. Inasmuch as cold air settles to the lower levels, low places are more subject to frost than those areas which are somewhat elevated, and it is for this reason that good air drainage, like good soil drainage, is essential.

THE ASPECT.

The aspect or slope of the plantation is a matter of considerable importance, but inasmuch as opinions among those of great experience differ widely in regard to the *best* slope for any particular fruit, it is obvious that no arbitrary directions can be given. In fact, the great diversity of opinion in regard to the matter is sufficient proof that no one slope or exposure is invariably the best, but that each one may have some advantage over any other for particular objects or conditions.

In general, a southern exposure ripens fruit earlier than any other, but for some fruits, especially those which blossom very early, this may

be the one slope of all others to be avoided. Doubtless fruits will color more highly on a southern or southeastern exposure than on a northern or western slope. The object most desired should be prominently in mind, and then, if possible, the exposure selected which will contribute most to the desired end.

VARIETIES.

The variety problem is a fundamental one; the value of a plantation is largely measured by its proper solution. There is no question so frequently asked by prospective planters of fruit as "What varieties shall I plant?" It is one of the most difficult problems concerning which to give advice. The soil, climate, purpose for which grown, and various other factors must be taken into consideration; each one has its own influence upon the behavior of a variety. Even the likes and dislikes of the grower are not without their effects, for if he takes a special liking to the Delaware grape or the Grimes apple he will almost unconsciously give these varieties better attention than he will a variety for which he has no special fondness, and, in general, better attention means better results.

Yet it must be kept in mind that varieties are, in a large measure, the result of conditions under which they grow, and as the conditions vary the variety is modified also. A kind that is successful in a given place is not necessarily satisfactory in some other location with different conditions.

Advice regarding the most suitable varieties for any location should be based on a knowledge of the influencing conditions which exist and the objects for which the fruit is desired. If the fruit is grown for home use, quality rather than productiveness should be a ruling factor, while for commercial purposes, heavy bearing habits and good shipping qualities are the more essential characteristics. In like manner, some varieties are well suited to nearby markets where the fruit is delivered direct to the consumer, which are not satisfactory for sending to distant points. The best guide that can possibly be had is the behavior of varieties growing under conditions similar to those where it is desired to make the plantation.

The prospective planter, knowing his own conditions, should carefully study fruit-growing regions with conditions as nearly like his as possible, and be guided in selecting his varieties by their behavior where he has seen them growing.

The best published list of varieties is the "Revised Catalogue of Fruits" prepared by the American Pomological Society and published as Bulletin No. 8 of the Division of Pomology, United States Department of Agriculture. In this bulletin the country is divided into nineteen fruit districts, with lists of varieties of the principal kinds of fruits that may be expected to give satisfaction within the areas designated. These lists, however, are subject to revision and correction.

SELECTING AND PLANTING THE STOCK.

THE STOCK.

Good stock should always be insisted upon. Such stock does not necessarily call for the largest plants of the kind that can be secured, but should consist of strong, healthy plants of fair size for the age, with good roots and typical of the variety. It is false economy to secure low-grade stock simply because the first cost is a little less than that of better grades.

PREPARING THE LAND.

Land can not be too carefully prepared before it receives the plants. This is especially true where strawberry plants or other small fruits are to be set out. The soil should be as thoroughly pulverized as for a seed bed. Of course, in the case of orchard lands the most of the surface can be readily worked after the trees are planted, but in most cases it will be found more satisfactory to attend to all such details before any of the ground is occupied by trees or plants of any kind.

SETTING THE PLANTS.

If extensive areas are to be planted it will often be found economical to make furrows along the line of the rows, and of sufficient depth to receive the plants, though this is one of the many details that is a matter of personal preference. The essential feature of the operation is to make the holes that are to receive the plants sufficiently broad to take the roots without bending them from their natural positions, and deep enough so that when they are refilled the plants shall be somewhat deeper—in the case of most kinds of trees, two or three inches—than they were in the nursery row. But in setting out strawberry plants and others of similar nature care must be taken not to cover the crown of the plants. The soil needs to be packed about the roots very firmly.

Before setting in the ground, all mangled or bruised roots should be removed and the tops cut back proportionately to the amount of the root system that has been lost. It is the practice of some growers in setting trees to trim to a mere whip by removing all the side branches. With peach trees this is the more usual custom, unless the trees are very large.

The practice which is quite common, especially among small growers, of placing a quantity of manure in the bottom of the holes before setting trees is not one to be commended. If the manure heats, it is likely to cause the drying out of the roots, thus defeating the very object of the intended extra attention. It is better to have the soil uniformly in good condition before planting the stock.

PRUNING.

Only a brief reference to this feature of fruit growing can be made at this time. Every kind of tree or plant, in fact, every individual, presents its own peculiar problems to the pruner. Hence no arbitrary rules can be given. To do the work most judiciously the operator must understand the principles involved, then apply them to each case. Skill in pruning can come only with experience and practice.

Perhaps the most important thing is to observe the manner in which the fruit is borne. For instance, an apple or pear tree bears its fruit mostly on "fruit spurs," and so would not be pruned in the same way as a peach tree, which bears its fruit only on last season's growth. A quince tree, which produces its fruit on the tips of the growth made the present season, would naturally be pruned differently from either an apple or peach tree. Likewise, the correct pruning of grapes is based on the fact that the shoots of the present season produce this year's crop. The same principle in pruning holds true throughout the whole list of fruits—that is, the manner in which the fruit is borne should govern the manner of pruning.

In a general way, it may be said in regard to tree fruits that all dead branches should be removed and the top of the trees be kept sufficiently open to admit an abundance of sunlight for the coloring of the fruit. Reasonably open tops are also of great advantage in spraying the trees and in harvesting the fruit. The natural habit of the tree should suggest the form to be adopted by the pruner. In other words, a tree the branches of which naturally droop can not well be pruned to an upright form, and a tree with a strong tendency toward forming an upright head can not readily be made to assume a decidedly spreading form. Of course these natural tendencies can be influenced in a measure by the manner of pruning, but they can not be entirely overcome. The tops should be kept symmetrical and as well balanced as possible.

The pruning of the various kinds of small fruits is based on the same general principles as the pruning of fruit trees—that is, the manner in which the fruit is borne and the character of the growth should govern the method of pruning.

FERTILIZING THE PLANTATION.

Problems relating to the fertilizing of fruit lands are very local, and depend upon the physical conditions of the soil and the amount of available plant food which it contains. Generally speaking, fruits require large quantities of potash to bring them to their highest state of development, but liberal supplies of the other plant foods are also essential. The only way of determining what is necessary is to intelligently study the behavior of the plants and be governed thereby. A series of experiments, in which different combinations and different

quantities of plant foods are used, is always of great assistance in determining upon an economical use of fertilizers. In fact, such a line of experiments is the only way of getting definite data upon the matter.

The fact needs emphasis, however, that the production of heavy crops of fruit is a severe drain upon the fertility of the soil, and unless some means are resorted to to maintain it, soil exhaustion will sooner or later follow, resulting in unproductive plantations.

The economical use of fertilizers is based on the natural producing capacity of the soil. It follows then from this, that a combination of plant foods which is suited to a given plantation is not necessarily suited to any other plantation. In fact, it would not be unless the conditions of soil fertility were the same. Such a series of experiments as suggested above would reveal in the best way possible what these conditions are, thereby making an economical use of fertilizer possible.

COVER CROPS.

The use of cover crops in connection with the growing of fruits is closely allied to the fertilizer problem, inasmuch as they are both fundamental factors in soil fertility.

The producing capacity of the soil is as much dependent upon its physical or mechanical condition as it is upon the amount of plant food it may contain. The chief factor governing the physical condition of the soil is the amount of humus or decaying vegetable matter it contains. It is in this connection that cover crops may be made to serve so important a purpose.

Cover crops are of two classes: Legumes, which have the power of gathering nitrogen from the air, so that when they are plowed under and decay the soil is actually richer in nitrogen than it was before; and the nonnitrogen-gathering plants, which, when they become incorporated with the soil, leave it little richer in plant food than it was before, though the presence of the decaying vegetable matter thus added to the soil improves its physical condition and makes it more productive.

Of the leguminous cover crops, the various kinds of clovers are perhaps of greatest value, though the question of value is somewhat dependent upon location and other conditions. Other crops of this class frequently used for the purpose in question are vetch, cowpeas, Canada field peas, and several others. Rye, buckwheat, rape, and the like are the more common nonleguminous plants used for cover crops.

Other things being equal, the ideal time to sow the cover crop is at the last cultivation of the plantation for the season, allowing it to remain upon the ground until the first working of the soil the following spring. Various factors, however, will influence the details of management. If, in the judgment of the grower, the soil needs more

nitrogen, one of the leguminous crops should be sown. If only the maintenance of the humus is necessary, together with the protection of the soil during winter, then one of the nonleguminous crops will serve the purpose.

TILLAGE.

As a fundamental factor in progressive orchard management, systematic tillage is a practice of comparatively recent introduction. While the practice has become quite general during the past few years and is growing more so, the principles underlying the operation are not so fully understood as they should be. A better understanding of these principles will make the operation more effective, because it will be more thorough.

The offices of tillage are several. Among the more important ones are:

1. The setting free of plant food by increasing the chemical activities in the soil.
2. The soil is made finer and hence presents greater surfaces to the roots, thus increasing the area from which the roots can absorb nutriment.
3. The surface of the soil is kept in such condition that it immediately absorbs all the rain that falls during the summer, when it is apt to be dry. Little is lost by surface drainage.
4. Moisture is conserved thereby. Where the surface remains undisturbed for weeks the soil becomes packed, so that the moisture from below readily passes to the surface and is evaporated, thus being lost to the growing crop. If the surface is kept light and loose by tillage, so that the capillarity is broken, but little of the soil moisture comes to the surface and evaporation is not so great. In this way nearly all the moisture remains in the soil, where it can be used by the plants.
5. Thorough tillage has a tendency to cause deeper rooting of the plants. The surface of the soil is made drier by tillage during the early part of the season than it would otherwise be; hence the roots go where the soil is moist. The advantage of deep rooting during drought is obvious.

The relation of plant food and moisture to the welfare of crops and the influence of tillage thereon should perhaps receive some further attention. Doubtless all farm crops—not excepting the tree fruits—suffer more from lack of moisture than they do from lack of plant food in the soil. All of the nourishment which the plant gets from the soil is taken in solution, and unless there is an abundance of soil moisture to dissolve the mineral plant foods it is evident that their presence in the soil, even in limitless quantities, could avail nothing for the good of the crop. The ideal tillage, then, is that which begins as early in the season as the soil can be worked, while there is still an abundance of moisture in it, and continues until mid season—that is, through the growing season of the plant. The aim should be to keep the surface, to the depth of 2 or 3 inches, as light and as loose as possible. This

will be equivalent, so far as conserving the moisture is concerned, to spreading a mulch of straw or sawdust over the soil. The constantly moist condition of the soil under such a mulch is a matter of frequent observation.

But tillage, to be of value in fruit growing, must be practiced judiciously. If the soil is tilled when it is too wet, more damage may be done by a single cultivation than a whole season's effort in corrective methods can overcome.

There are cases where conditions will suggest that tillage of any kind is unwise. Such fruits as the strawberry, which produces its crop close to the ground and early in the season, obviously should receive little if any cultivation before the fruit is harvested. The practice of tillage, however, is correct in principle. The wisdom of the grower must suggest the proper application of it.

MARKETING THE PRODUCT.

The growing of fruit and marketing it may properly be considered two distinct lines of business. It frequently happens that a grower produces the highest quality and grade of fruit, and yet because of faulty methods of marketing or handling he makes a failure, financially, of his efforts. The successful marketing of fruit requires a very close and constant study of the markets—closer than the average fruit grower is likely to give—and the exercise of the best business ability.

GRADING AND PACKING.

The markets are seldom glutted with strictly first-class fruit, if properly packed, but it frequently happens that the poorer grades are a burden at any price. The demands of the various markets, however, vary as to requirements in grade and style of package; so it is essential that the shipper be familiar with the standards of the market to which he is shipping. For instance, a market where a large portion of the fruit goes to canneries would not be so critical of detail in grading, packing, and style of package as would another market where a fancy dessert trade governs the demand. The necessity of knowing the demands of the market for which the fruit is intended and then honestly catering to it, are the points to be emphasized in this connection.

Honest grading and packing are essential points. It sometimes happens that the grower's standards of grade and quantity are below those of the market, and while he thinks he is packing fruit requisite for the grade intended he is disappointed in the returns from his commission house, even though the returns were honestly made. A personal inspection of the markets and a conference with the commission merchant himself would often make pleasanter relations between the two. The grower would then see for himself just what the market demands.

THE GROWER AND THE COMMISSION MAN.

The commission house, an essential adjunct to commercial fruit growing, is often bitterly assailed by the grower. Some of this criticism is just, but much of it unjust. Each grower should select some honest house to deal with in each market to which he ships, and then stick to it. Growers often ship first to one house, then to another, and so on, not dealing with any one long enough to make a reputation either for himself or for his fruit. A good reputation with the commission merchant who handles his fruit is often of immense advantage to the grower. A common occurrence will illustrate the fact. Upon making a shipment the grower notifies his agent of what the shipment consists. Knowing that the packing and grading are thoroughly honest, the commission merchant can safely sell the fruit without the necessity of examining it, and often does dispose of such lots before they are received, and at a good price. If, however, he knows nothing of the shipper's methods or, as may be the case, he knows that his grading is irregular and packing faulty, he (the commission merchant) must see the fruit before he can sell it, and being thus delayed, this fruit must take its chances when the demand has been partially supplied and prices have been correspondingly lowered.

Some growers practice dividing their shipments, even in the same market, between several commission houses. This is unwise, as it brings fruit of the same class into competition with itself. It may be of no disadvantage to consign the different grades to different houses in the same market, but the most sagacious growers refrain, as a rule, from dividing their shipments if the whole consignment is sent to the same market. To successfully handle fruit the best of business ability and keen foresight need to be exercised, and where these qualities are displayed the growers generally find fruit growing profitable.

HYGIENE OF THE FRUIT PLANTATION.

A healthy condition of the fruit plantation is an all important consideration, and no pains should be spared to keep the plants strong and thrifty. Many of the factors which influence the vigor of plants are directly within the control of the grower. Some of them have already been referred to in other connections.

The first two essentials are good, strong, healthy plants when they are set out and a suitable place in which to grow them. If either one of these two points is disregarded, little or nothing can be done to offset or remedy the initial difficulty; but with these two conditions properly met, the health of a plantation is largely a matter of good judgment on the part of the grower in his management of it. Thorough and judicious fertilizing, pruning, cultivating, spraying, etc., will do much toward keeping the plants in the most favorable condition for fruit production. Adverse climatic influences will sometimes defeat the

most intelligent efforts, but by careful attention to all the details that go to make up progressive fruit-plantation management the grower is able to minimize the effect of adverse influences which otherwise tend to weaken or impair the vigor of his plants.

THE SPRAYING PROBLEM.

Spraying is a comparatively recent development as a generally important operation in the growing of fruits. The general distribution of the potato beetle in the early seventies made the use of arsenic in some form familiar in controlling this pest. It was also used in combatting the cotton worm at a relatively early date, but it was not until within the past fifteen years or so that the spraying of plants and fruit trees began to receive any special attention. In recent years, however, great progress has been made in this direction. Much yet remains to be learned, but the general principles are now well established. Advancement in the future will lie along the lines of better insecticides and fungicides, and improved means of applying them.

THE PHILOSOPHY OF SPRAYING.

An operation can always be more intelligently performed if the reasons for doing it are thoroughly understood. This is emphatically true of spraying. If the operator does not know what he is spraying for and why he is doing it, it is merely an accident if his efforts avail anything. It is not necessary that he know the name of every disease or the complete life history of every insect, but it is essential for him to know their vulnerable points and the treatment that will reach them.

Spraying for fungous diseases is largely a preventive measure, not a curative one; hence their coming must be anticipated. This likewise applies to some of the insect pests. Spraying should therefore be looked upon as an *insurance* of the crop. Such efforts will not give the same proportionate returns every year, but the appearance of destructive diseases and insects of some kind may be expected every season and it is not often that they fail to come, so that efforts put forth in anticipation are seldom lost.

The effect of spraying is, in a measure, cumulative. The benefits are not all manifest during the season that the application is made. Especially is this true of plants which form their fruit buds the previous season, which is the case with most of the fruits. An apple tree, for instance, which is seriously attacked by insects or loses its foliage from disease, is not likely to properly mature its fruit buds for the next season's crop, whereas a tree that is perfectly healthy will, under normal conditions, perfect its fruit buds for the succeeding season.

Thoroughness is an absolute essential. Negligence in this direction is the cause of a large proportion of the failures to obtain good results from spraying. To spray a plant thoroughly, it is not necessary to

drench it until the mixture drips from the leaves, but the aim should be to completely moisten the entire surface of foliage and branches. Other common causes of failure are applying the wrong remedy, or the right remedy at the wrong time. A frequent mistake is the use of insecticides where fungicides ought to be used, and vice versa. Then the operator, having failed to distinguish the proper remedy, wonders why his spraying is so unsuccessful. These points will be referred to elsewhere more in detail.

LOGICAL PLACE OF SPRAYING IN FRUIT-PLANTATION MANAGEMENT.

Spraying is coordinate with tillage, pruning, fertilizing, and the other fundamental operations of fruit raising, but as it is really an *insurance* of the crop its logical order follows after the other operations have received attention from the grower. That is to say, spraying will in no way take the place of tillage, fertilizing, etc., but when these matters have all been properly attended to, and the devastation of insect enemies and fungous diseases are the remaining factors which are likely to prevent the development of the fruit, then spraying remains as the one other essential thing to be regarded. A plantation that is suffering from lack of tillage, poverty of soil, or various other essentials, can not be made profitable merely by spraying. Special emphasis is laid on this point because many who are struggling with neglected and unprofitable fruit plantations, not appreciating the proper place of spraying in fruit raising, have conceived the notion that if they only resort to spraying their plantations will at once become fruitful. Spraying, then, is of value in fruit growing only so far as it decreases the devastations due to insects and fungous diseases.

SPRAYING IN RELATION TO INSECTS.

The limitations of the present discussion will permit only a general reference to this feature of fruit growing. To be effective, a proper remedy must be applied at the proper time. As a rule insects do the greatest amount of damage during their larval or immature stage, and generally it is unnecessary to spray before the appearance of this form, but in a few cases their coming must be anticipated and some means of control resorted to before the insects appear.

For insects which eat the foliage or other portions of the host plant some poison, as paris green, should usually be applied. Sucking insects, such as plant lice, require an insecticide that kills by coming in contact with them. Kerosene in some form is widely used for this purpose.

Some insects can not be reached by sprays of any kind, and such means of combating them must be adopted in these cases as will reach an assailable point in the life cycle of the insect. Sometimes hand

picking is the best method of control. In others, the destruction of the infested plants is the only satisfactory resort. In all cases of doubt the advice of some entomologist or other competent person should be obtained.

The preparation of insecticides, while not difficult, requires care and much regard for the details. Numerous publications of the Department of Agriculture and State experiment stations, giving explicit instructions for their preparation, are available for those who wish them.

Fruit growers are often at a loss to know where to look for assistance when confronted with insect problems, and for this reason allow their crops to suffer from insect injury which might otherwise be prevented. The following publications of the United States Department of Agriculture, Division of Entomology, are suggested as aids to those who are concerned with the subjects treated: Circular No. 7, The Pear-tree Psylla; Circular No. 9, Canker worm; Circular No. 17, The Peach-tree Borer; Circular No. 20, The Woolly Aphis of the Apple; Circular No. 21, The Strawberry Weevil; Circular No. 23, The Buffalo Tree Hopper; Circular No. 26, The Pear Slug; Circular No. 29, The Fruit-tree Bark-beetle; Circular No. 32, The Larger Apple-tree Borers; Circular No. 42, How to Control the San José Scale; Bulletin No. 34, Principal Insects Liable to be Distributed on Nursery Stock; Bulletin No. 35, Codling Moth Investigations; Reprint from Yearbook for 1896, Insect Control in California; Reprint from Yearbook for 1900, Scale Insect and Mite Enemies of Citrus Trees. Also several of the Farmers' Bulletins mentioned on page 25 will be found valuable in dealing with insects.

SPRAYING IN RELATION TO PLANT DISEASES.

The fact needs repeated emphasis, that spraying to control fungous diseases of plants is primarily a preventive measure. If the applications are delayed until after the plants have become diseased, very little can be accomplished by the use of fungicides. In order to insure the greatest degree of protection, it is necessary to keep the foliage as completely covered as possible with some fungicide during the period of growth of those diseases to which the plant in question is subject; otherwise the very minute spores of the diseases liable to attack the plants in question may lodge on unprotected spots and so develop their respective diseases within the tissues of the host. For this reason repeated applications are necessary. As the object is to keep every portion of the foliage covered with the fungicide used, it is obvious that very careful attention to its application is essential.

Failure to make the applications thorough is the source of much dissatisfaction with the results of spraying. Another difficulty is in

using fungicides that are not properly made. It is not difficult to prepare the ones of greatest importance in fruit growing, but attention to details is of fully as great importance as in the preparation of insecticides. Explicit directions for making Bordeaux mixture and ammoniacal solution of copper carbonate, which are the most important fungicides in general use, are given in Farmers' Bulletin No. 38, Spraying for Fruit Diseases, published by this Department. Bulletin No. 8, Principal Diseases of Citrus Fruits in Florida, and No. 20, Peach-Leaf Curl; Its Nature and Treatment—two bulletins from the Division of Vegetable Physiology and Pathology of this Department—will also be of value to many fruit growers. Useful Farmers' Bulletins are also mentioned on page 25.

COMBINATION OF INSECTICIDES AND FUNGICIDES.

Many of the most troublesome insects and plant diseases require attention at the same time. By uniting the spraying materials the two objects can often be accomplished with a single application. The combination in most common use is Bordeaux mixture and Paris green, or some other form of arsenic. The poison is added to the fungicide in the same manner and at the same rate as it would be if it were applied in water alone.

Contact insecticides are generally applied by themselves, without being combined with a fungicide.

THE DUST METHOD.

Spraying materials have been applied more or less from the first in the form of a dry powder, usually diluted with slaked lime, flour, or some other cheap substance. This method has generally been used in treating low-growing plants like potatoes, but in some sections it has, within the last few years, been given a wider application and used in combating orchard pests. It is highly recommended by some of those who have adopted it, and appears to be of growing importance. It would seem to be of special value in places where it is difficult to get water for the wet method. Several machines for dusting plants and trees are on the market.

SPRAYING APPARATUS.

The apparatus used in the early days of spraying would hardly be recognized as the prototype of that in common use at the present time. The first device for applying insecticides and fungicides was merely a brush. It was used by first dipping it into the liquid and then spattering over the plants. Common gardeners' watering pots with fine roses were also used in the early history of spraying, especially in fighting potato bugs.

The early spray pumps were quite unlike those of to-day. They were heavy, clumsy affairs, projecting far above the barrels or tanks on which they were mounted, thus being top-heavy and inconvenient for moving about.

The question, "What is the best spray pump?" is a very common one, and one which admits of no direct answer. There is a large number of good spray pumps, and the one a fruit grower likes best will depend in a measure upon what one he gets accustomed to first. As is the case with nearly all farm implements, if a man becomes accustomed to a particular make or style and it does good work, he will probably be better pleased with that one than he will with some other one which he does not understand so well, even though the two have intrinsically equal merits. Then, too, a grower should consider his own peculiar needs and be governed thereby in selecting his apparatus. Some pumps are better adapted to special needs than others.

VARIOUS STYLES AND TYPES OF PUMPS, ETC.

The following notes are intended merely to call attention to some of the more important kinds of spraying apparatus that are readily obtainable.

Points of a good pump.—The pump should have sufficient strength and capacity for the purpose intended. The air chamber should be large enough to insure a steady spray and be so placed that the pump is not made top-heavy or unduly cumbersome thereby.

The valves, plunger, and other working parts should be made of brass, else corrosion will occur. The different portions of the pump

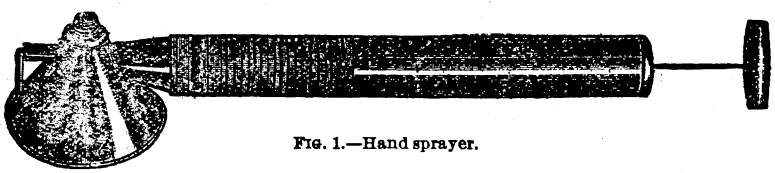

FIG. 1.—Hand sprayer.

should be so constructed that they can be readily taken apart, especially those portions that inclose the valves. If a barrel pump, it is desirable that the device for attaching the pump to the barrel be so made that the former can be readily mounted or removed from the barrel. All nipples for the attachment of hose should be cut with threads of standard size. A pump should be as compact as is consistent with the work required of it.

Hand sprayers.—These are small sprayers or atomizers of slight cost and narrow range of usefulness, but of value about the home garden or dooryard, where the limited extent of spraying to be done does not warrant the expense necessary to procure more efficient apparatus. Fig. 1 illustrates this type.

Bucket pump.—Small force pumps, attachable to a bucket, are often useful about the home grounds. With proper accessories trees 10 or 15 feet high can be sprayed, but their capacity is too small to recommend them for other than garden operations. (See fig. 2.)

FIG. 2.—Bucket pump.

Knapsack pump.—This type is shown in fig. 3. While not adapted for spraying plants much taller than a man, it is very useful for treating potatoes and other plants of low growth, especially if they are not accessible with the larger pumps which require a team to draw them.

Barrel pump.—For the average fruit grower this is the most important type of pump. As the name implies, it is usually mounted on a barrel or some larger tank and drawn about on a stone boat or wagon. Fig. 4 illustrates a convenient style. In

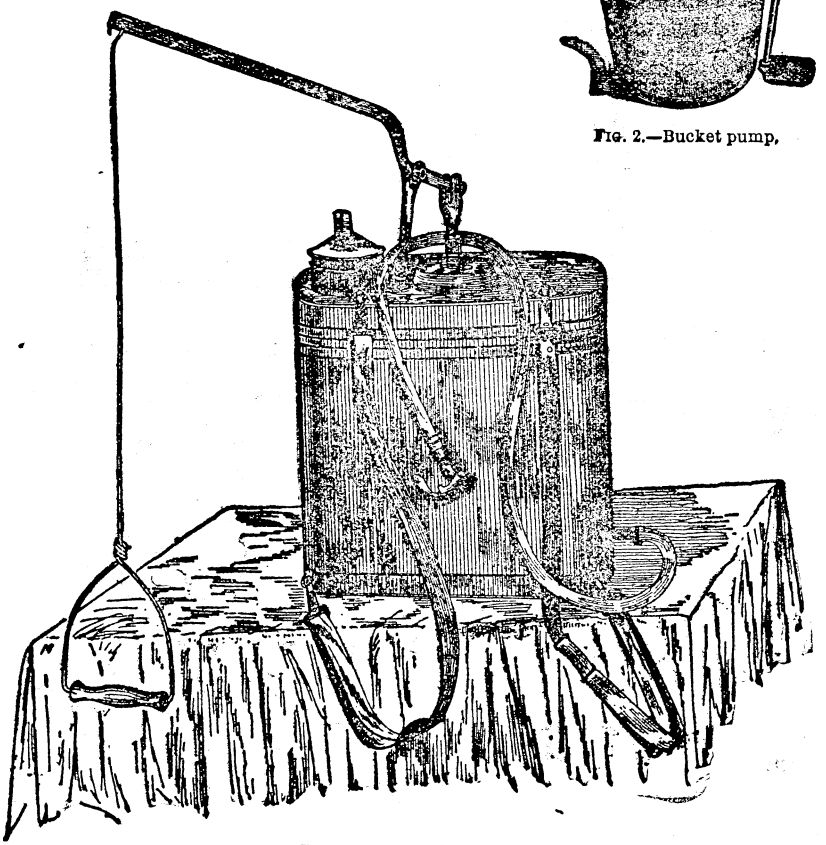

FIG. 3.—Knapsack pump.

this one the working parts are easily accessible, the pump projects only slightly above the barrel, it works easily, and with good care is very durable.

Horizontal pump.—This is a very strong, heavy type, capable of supplying several lines of hose, and so of particular value on plantations where a great amount of spraying is done. The working parts are in a horizontal position instead of vertical, as in the barrel type. They are mounted on a platform with the tank containing the spraying material and are connected with the latter by a suction hose and not placed within the tank, as is the case with barrel pumps. The pump shown on the platform in fig. 8 is of this type.

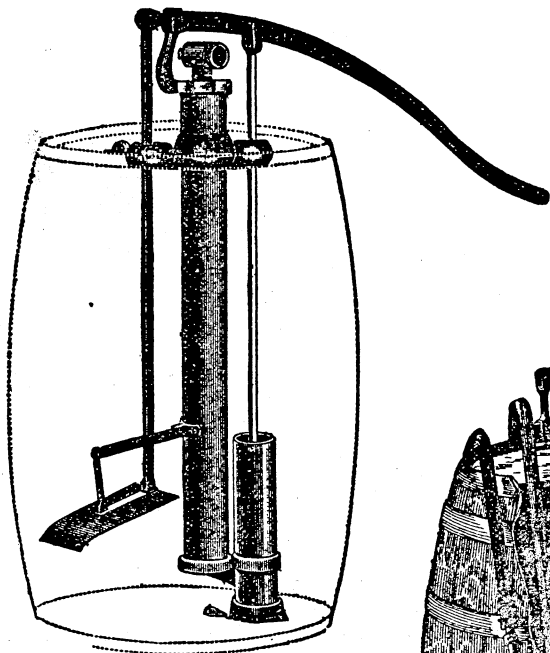

FIG. 4.—Barrel pump.

FIG. 5.—Kerosene pump in barrel.

Kerosene pump.—The usefulness of kerosene in combating sucking insects has led to the development in recent years of spraying apparatus especially adapted to applying it. These pumps have a tank attached to them for holding kerosene, and are so constructed that a mechanical mixture of the oil and water is made, containing any desired percentage. Fig. 5 illustrates one of these pumps intended for mounting in a barrel. They may be had also in the form of bucket and knapsack pumps.

Power sprayer.—This is a general designation for sprayers that are operated by some power other than hand labor. Fig. 6 shows an

outfit in which the pump is operated by a sprocket wheel and chain attachment. But rigs that depend upon the forward movement of the wheels for working the pump are not generally satisfactory. It often happens that a tree can not be thoroughly sprayed in the time taken for the team to pass it, and as the force is exhausted by a moment's stopping of the team, it necessarily follows that thorough spraying can not be assured.

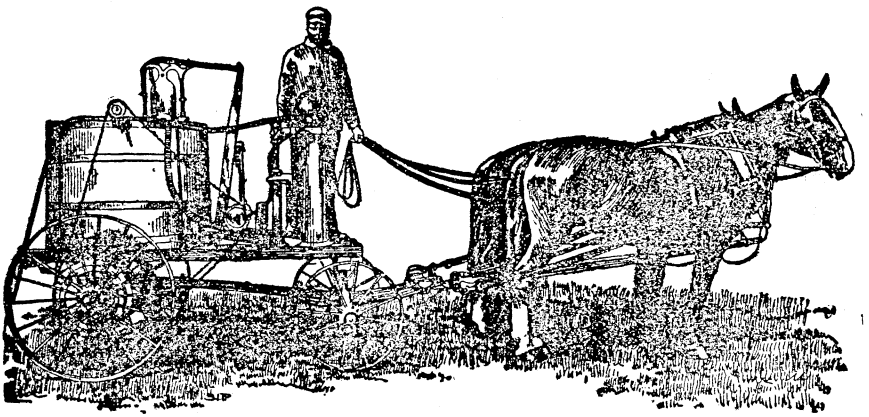

FIG. 6.—Spraying outfit operated by sprocket wheel and chain attachment.

Various combinations have been made with small engines for the motive power, but such outfits have not come into general use, though in extensive plantations they are being used more and more.

OTHER ACCESSORIES.

Nozzles.—A good nozzle is essential to thorough spraying. Other things being equal, the one that will throw the finest spray the greatest distance is the best. A nozzle that throws the liquid in the form of drops not only wastes the material, but applies it less thoroughly than does one the spray from which approaches a mist. Still, the nozzle must have the capacity to discharge the material fast enough for rapid work when in use. A combination of several nozzles, each with a small discharge, but making a very fine spray, is often used. The combined capacity of the nozzles enables rapid application of the mixture.

Nozzles are of two general types as regards the shape of the spray which they make—conical and fan shaped. Individual likes and dislikes will generally determine which is preferable.

Hose.—A good grade of three or four ply one-half inch garden hose is commonly used for extensive operations; three-eighths inch or even quarter inch is sufficiently large for bucket and knapsack pumps. The size refers to the inside diameter.

The length of hose required will depend upon the height of the

plants to be sprayed and the other accessories used. If, for instance, the man who handles the nozzle is working from the ground and is spraying trees the size of an average mature peach tree, a line of hose 20 feet long with an 8 or 10 foot extension rod will not be found excessive. If he is working from a raised platform a shorter length can be used.

Extension rods.—When trees of considerable height are to be sprayed it is often necessary, for thorough work, to elevate the nozzle to a greater distance than can be done with it attached directly to the hose, or if working from a platform, to extend it to the center of a tree. An "extension rod" bearing the nozzle at its outer extremity and attached to the hose makes thorough spraying possible under such conditions. Bamboo rods with light copper tubing extending through them make the most satisfactory accessories of this kind.

SPRAYING OUTFITS FOR ORCHARD WORK.

On account of the importance of orchard spraying, reference to outfits especially designed for the purpose may not be amiss. Reference

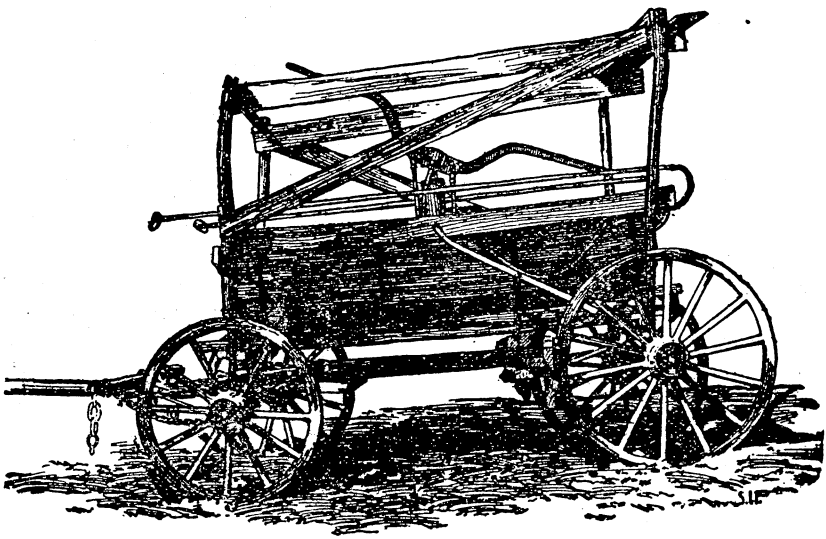

FIG. 7.—Spraying outfit with top of tank as platform.

to the accompanying illustrations will, however, present the suggestions that are necessary. Fig. 7 shows a tank which serves the double purpose of a receptacle for the spraying material and a platform from which the men handling the nozzles can work. The railing above the tank gives security to the men working upon it.

Fig. 8 shows a rig designed for spraying tall apple trees and the like. In this one, the platform is raised above the tank and supported by two strongly braced standards. This design is especially suitable

where the tops are close together. The standards are in the center and the platform is sufficiently high to escape the branches in most cases. This device permits passing through the orchard without seriously interfering with the trees. When such rigs are used, it requires one man to each line of hose and another to work the pump and manage the team.

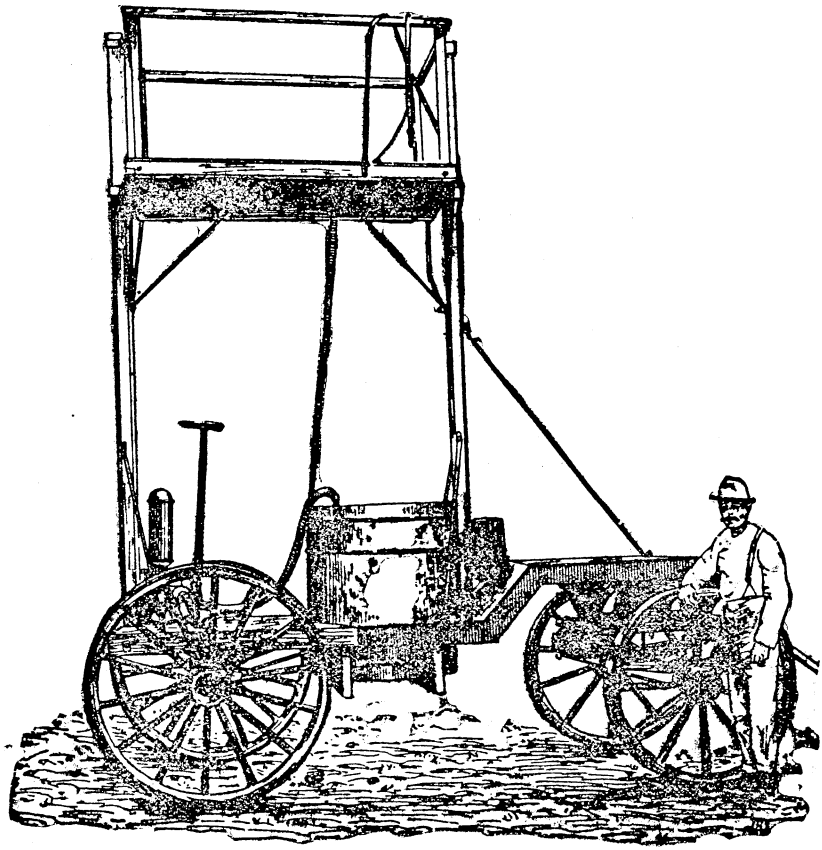

FIG. 8.—Spraying outfit for treating tall trees.

DEPARTMENT OF AGRICULTURE AIDS.

The Department of Agriculture is ready to aid fruit growers in any practicable way to the extent of its resources. The Bureau of Plant Industry, through its pomologists and pathologists and their expert assistants, will give advice in specific cases where the applicant furnishes sufficient data and the importance of the matter warrants it.

Insect ravages and dangers should be referred to the Division of Entomology, where they will receive attention under the same conditions indicated in the previous paragraph.

Farmers' Bulletins treating features of fruit growing can be obtained without charge by application to the Division of Publications. Those already printed are as follows: No. 30, Grape Diseases on the Pacific Coast; No. 33, Peach Growing for Market; No. 38, Spraying for Fruit Diseases; No. 70, Insect Enemies of the Grape; No. 80, The Peach Twig-Borer; No. 113, The Apple and How to Grow It; No. 118, Grape Growing in the South; No. 127, Important Insecticides; No. 140, Pineapple Growing; No. 145, Carbon Bisulphid as an Insecticide; No. 146, Insecticides and Fungicides; No. 153, Orchard Enemies in the Pacific Northwest; No. 154, The Fruit Garden: Preparation and Care; No. 156, The Home Vineyard. The Division of Publications also will send such other available publications as are shown by any application to be needed.

THE STATE EXPERIMENT STATIONS AS A SOURCE OF INFORMATION.

It may not be out of place to call the attention of fruit growers to the agricultural experiment stations as a source of assistance in solving the problems that confront them. Many of these problems require an intimate knowledge of existing conditions for their most satisfactory solution, and the station workers in each State may be expected to possess or at least be able to obtain information that will be of great assistance in many cases.

A great deal of valuable information is contained in the station publications; the bulletins issued by the station in each State are free to its residents. These bulletins are designed primarily to meet the peculiar conditions of the States wherein they are located. It thus becomes highly important for each fruit grower and for others interested in agricultural pursuits to keep in close touch with their experiment station. To this end a list of all the experiment stations is given on the next page, with the name of the executive officer of each. Questions relating to the care of fruit plantations, insect pests, fungous diseases, and other problems which the farmer meets may be submitted to the station in the State of which the inquirer is a resident, and assistance, so far as possible, secured.

AGRICULTURAL EXPERIMENT STATION ADDRESSES.

ALABAMA—
College Station: *Auburn;* ————
Canebrake Station: *Uniontown;* J. M. Richeson.*
Tuskegee Station: *Tuskegee:* G. W. Carver.*
ALASKA—*Sitka;* C. C. Georgeson.†
ARIZONA—*Tucson;* R. H. Forbes.*
ARKANSAS—*Fayetteville;* R. L. Bennett.*
CALIFORNIA—*Berkeley;* E. W. Hilgard.*
COLORADO—*Fort Collins;* L. G. Carpenter.*
CONNECTICUT—
State Station: *New Haven;* E. H. Jenkins.*
Storrs Station: *Storrs;* L. A. Clinton.‡
DELAWARE—*Newark;* A. T. Neale.*
FLORIDA—*Lake City;* T. H. Taliaferro.*
GEORGIA—*Experiment;* R. J. Redding.*
HAWAII—
Federal Station: *Honolulu;* J. G. Smith.†
Sugar Planters' Station—*Honolulu;* C. F. Eckart.*
IDAHO—*Moscow;* J. A. McLean.*
ILLINOIS—*Urbana;* E. Davenport.*
INDIANA—*Lafayette;* Henry A. Huston.*
IOWA—*Ames;* C. F. Curtiss.*
KANSAS—*Manhattan;* J. T. Willard.*
KENTUCKY—*Lexington;* M. A. Scovell.*
LOUISIANA—
State Station: *Baton Rouge;* ————
Sugar Station: *Audubon Park, New Orleans;* ————
North Louisiana Station: *Calhoun;* W. C. Stubbs.*
MAINE—*Orono;* C. D. Woods.*
MARYLAND—*College Park;* H. J. Patterson.*
MASSACHUSETTS—*Amherst;* H. H. Goodell.*
MICHIGAN—*Agricultural College;* C. D. Smith.*
MINNESOTA—*St. Anthony Park, St. Paul;* W. M. Liggett.*
MISSISSIPPI—*Agricultural College;* W. L. Hutchinson.*
MISSOURI—
College Station: *Columbia;* H. J. Waters.*
Fruit Station: *Mountain Grove;* J. T. Stinson.*
MONTANA—*Bozeman;* S. Fortier.*
NEBRASKA—*Lincoln;* E. A. Burnett.*
NEVADA—*Reno;* J. E. Stubbs.*
NEW HAMPSHIRE—*Durham;* F. W. Morse.§
NEW JERSEY—*New Brunswick;* E. B. Voorhees.*
NEW MEXICO—*Mesilla Park;* Luther Foster.*
NEW YORK—
State Station: *Geneva;* W. H. Jordan.*
Cornell Station: *Ithaca;* I. P. Roberts.*
NORTH CAROLINA—*Raleigh;* B. W. Kilgore.*
NORTH DAKOTA—*Agricultural College;* J. H. Worst.*
OHIO—*Wooster;* C. E. Thorne.*
OKLAHOMA—*Stillwater;* John Fields.*
OREGON—*Corvallis;* J. Withycombe.*
PENNSYLVANIA—*State College;* H. P. Armsby.*
PORTO RICO—*Rio Piedras;* F. D. Gardner.†
RHODE ISLAND—*Kingston;* H. J. Wheeler.*
SOUTH CAROLINA—*Clemson College;* P. H. Mell.*
SOUTH DAKOTA—*Brookings:* James W. Wilson.*
TENNESSEE—*Knoxville;* A. M. Soule.§
TEXAS—*College Station;* W. D. Gibbs.*
UTAH—*Logan;* J. A. Widtsoe.*
VERMONT—*Burlington;* J. L. Hills.*
VIRGINIA—*Blacksburg;* J. M. McBryde.*
WASHINGTON—*Pullman;* E. A. Bryan.*
WEST VIRGINIA—*Morgantown;* J. H. Stewart.*
WISCONSIN—*Madison;* W. A. Henry.*
WYOMING—*Laramie;* B. C. Buffum.*

* Director. † Special agent in charge. ‡ Acting director. § Vice-director.

NOTES REGARDING DEPARTMENT PUBLICATIONS.

The publications of the U. S. Department of Agriculture are mainly of three general classes:

I. Publications issued annually, comprising the Yearbooks, the Annual Reports of the Department, of the Bureau of Animal Industry, of the Bureau of Soils, and of the Weather Bureau.

II. Other Departmental reports, divisional bulletins, etc. Of these, each bureau, division, and office has its separate series in which the publications are numbered consecutively as issued. They comprise reports and discussions of a scientific or technical character.

III. Farmers' Bulletins, divisional circulars, reprinted Yearbook articles, and other popular papers.

The publications in Class I are distributed by the Department and by Senators and Representatives in Congress. For instance, of the 500,000 copies of the Yearbook usually issued, the Department is allotted only 30,000, while the remaining 470,000 copies are distributed by members of Congress. The Department's supply of the publications of this class is therefore limited, and consequently has to be reserved almost exclusively for distribution to its own special correspondents, and in return for services rendered.

The publications of Class II are not for distribution by members of Congress, and they are not issued in editions large enough to warrant free general distribution by the Department. The supply is used mainly for distribution to those who cooperate with the Department or render it some service, and to educational and other public institutions. A sample copy of this class of publications can usually be sent on application, but, aside from this, the Department generally finds it necessary to refer applicants to the Superintendent of Documents, of whom further mention is made below.

The publications of Class III treat in a practical way of subjects of particular interest to farmers. They are usually issued in large editions, and are for free general distribution by the Department. The Farmers' Bulletins are also for distribution by Senators and Representatives in Congress, to each of whom is furnished annually, according to law, a quota of several thousand copies for distribution among his constituents.

A limited supply of nearly all the publications in Classes I and II is, in compliance with the law, placed in the hands of the Superintendent of Documents for sale at cost of printing. Application for these should be addressed to the **Superintendent of Documents, Union Building, Washington, D. C.**, and should be accompanied by postal money order, payable to him for the amount of the price. No postage stamps or private checks should be sent. The Superintendent of Documents is not permitted to sell more than **one copy** of any public document to the same person. The Public Printer may sell to one person any number not to exceed 250 copies if ordered before the publication goes to press.

The Secretary of Agriculture has no voice in designating the public libraries which shall be the depositories of public documents. Of the distribution of documents to such depositories, including the publications of this and all other Departments of the Government, the Superintendent of Documents has full charge.

For publications of the Weather Bureau, requests and remittances should be directed to the Chief of the Weather Bureau.

The Department has no list of persons to whom all publications are sent. The monthly list, issued on the first day of each month, will be mailed regularly to all who apply for it. The Department also issues and sends out to all who apply for them a complete list of all publications of which the Department has a supply for free distribution, and a similar list of all the Department's publications for sale by the Superintendent of Documents.

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to Senators, Representatives, and Delegates in Congress, or to the Secretary of Agriculture, Washington, D. C. The missing numbers have been discontinued, being superseded by later bulletins.

16. Leguminous Plants. Pp. 24.
21. Barnyard Manure. Pp. 32.
22. The Feeding of Farm Animals. Pp. 32.
24. Hog Cholera and Swine Plague. Pp. 16.
26. Peanuts: Culture and Uses. Pp. 24.
27. Flax for Seed and Fiber. Pp. 16.
28. Weeds: And How to Kill Them. Pp. 32.
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76. Tomato Growing. Pp. 30.
77. The Liming of Soils. Pp. 19.
78. Experiment Station Work—V. Pp. 32.
79. Experiment Station Work—VI. Pp. 28.
80. The Peach Twig-borer. Pp. 16.
81. Corn Culture in the South. Pp. 24.
82. The Culture of Tobacco. Pp. 24.
83. Tobacco Soils. Pp. 23.
84. Experiment Station Work—VII. Pp. 32.
85. Fish as Food. Pp. 30.
86. Thirty Poisonous Plants. Pp. 32.
87. Experiment Station Work—VIII. Pp. 32.
88. Alkali Lands. Pp. 23.
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92. Experiment Station Work—IX. Pp. 30.
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124. Experiment Station Work—XVII. Pp. 32.
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126. Practical Suggestions for Farm Buildings. Pp. 48.
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156. The Home Vineyard. Pp. 24.
157. The Propagation of Plants. Pp. 24.
158. How to Build Small Irrigation Ditches. Pp. 28.
159. To be supplied.
160. Game Laws for 1902. Pp. 56.

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